OIPE JC100
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PATENT & TRADEMARK OFFICE

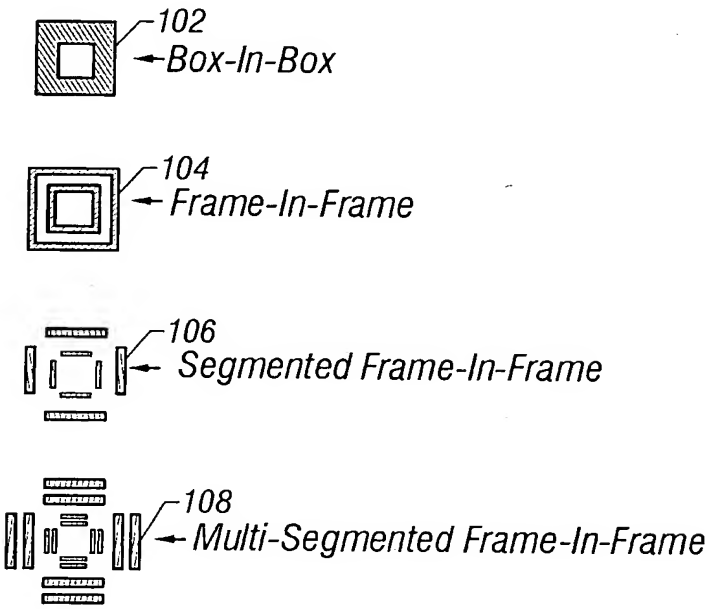


FIG. 1

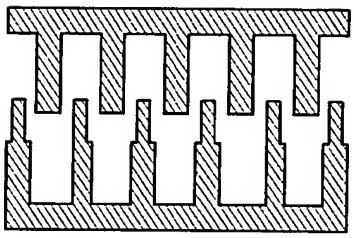


FIG. 2

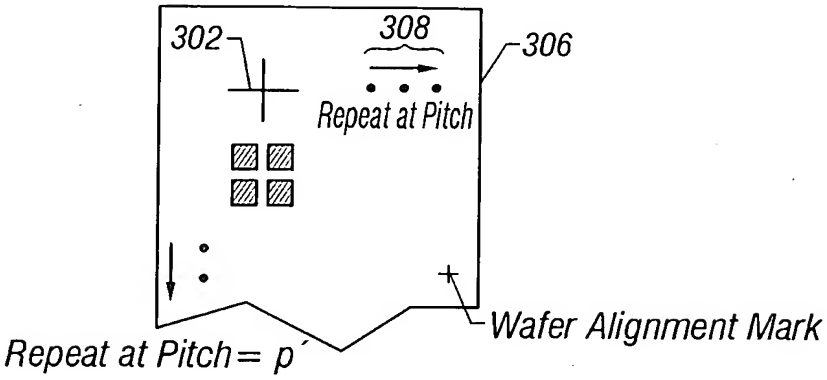


FIG. 3

FIG. 4

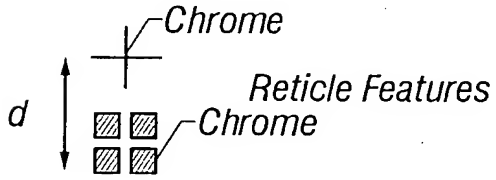


FIG. 5A

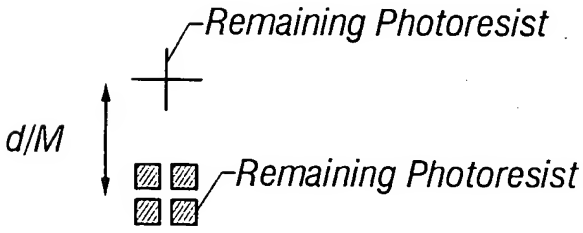


FIG. 5B

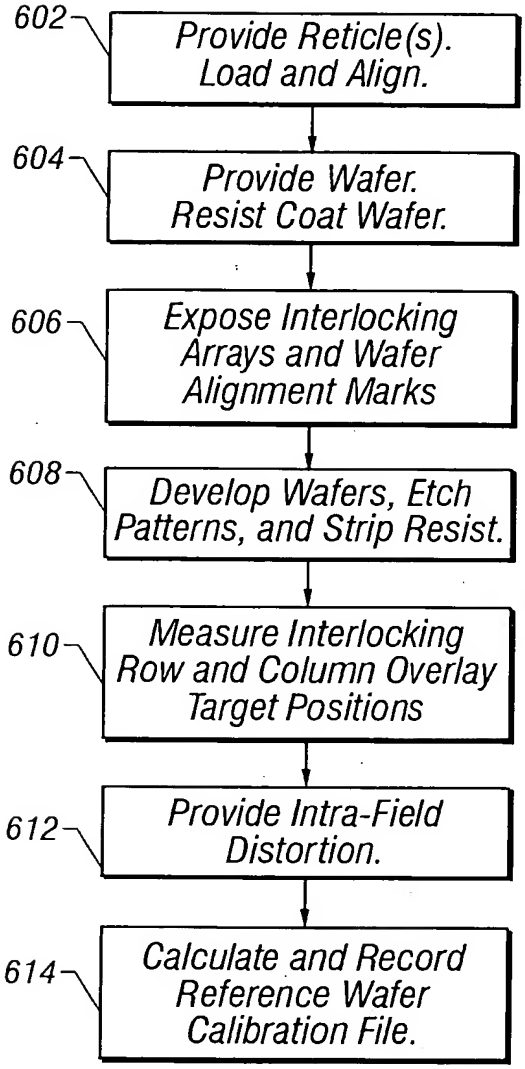

602
Provide Reticle(s). Load and Align.
604
Provide Wafer. Resist Coat Wafer.
606
Expose Interlocking Arrays and Wafer Alignment Marks
608
Develop Wafers, Etch Patterns, and Strip Resist.
610
Measure Interlocking Row and Column Overlay Target Positions
612
Provide Intra-Field Distortion.
614
Calculate and Record Reference Wafer Calibration File.

FIG. 6

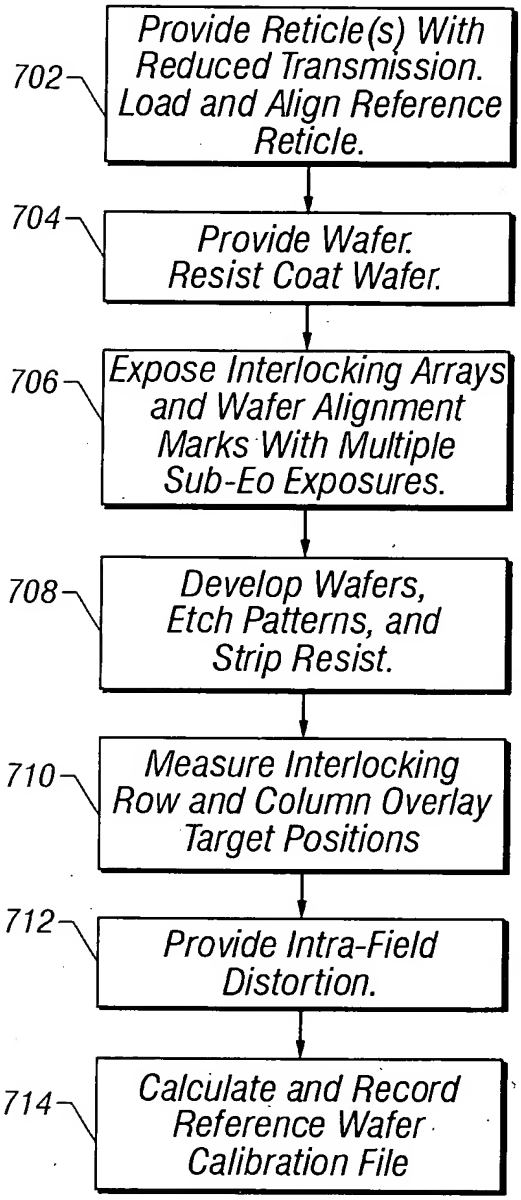

702
Provide Reticle(s) With Reduced Transmission. Load and Align Reference Reticle.
704
Provide Wafer. Resist Coat Wafer.
706
Expose Interlocking Arrays and Wafer Alignment Marks With Multiple Sub-Eo Exposures.
708
Develop Wafers, Etch Patterns, and Strip Resist.
710
Measure Interlocking Row and Column Overlay Target Positions
712
Provide Intra-Field Distortion.
714
Calculate and Record Reference Wafer Calibration File

FIG. 7

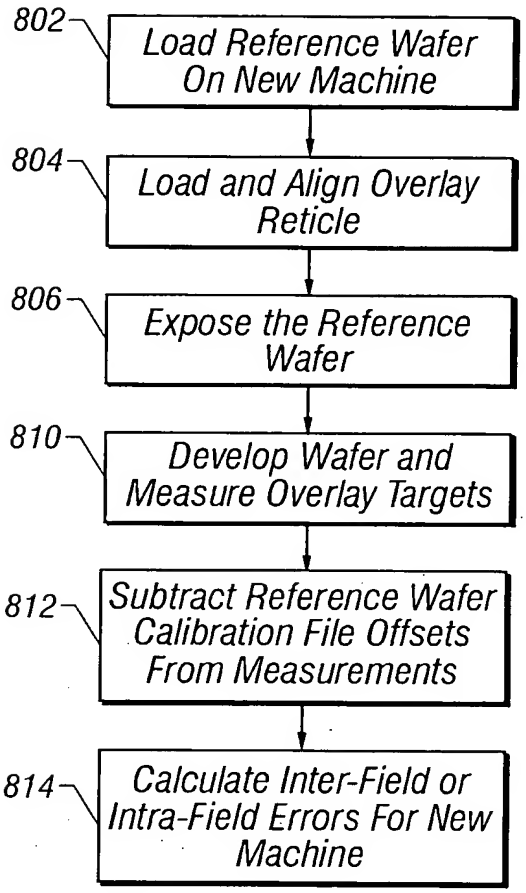

802
Load Reference Wafer On New Machine
804
Load and Align Overlay Reticle
806
Expose the Reference Wafer
810
Develop Wafer and Measure Overlay Targets
812
Subtract Reference Wafer Calibration File Offsets From Measurements
814
Calculate Inter-Field or Intra-Field Errors For New Machine

FIG. 8

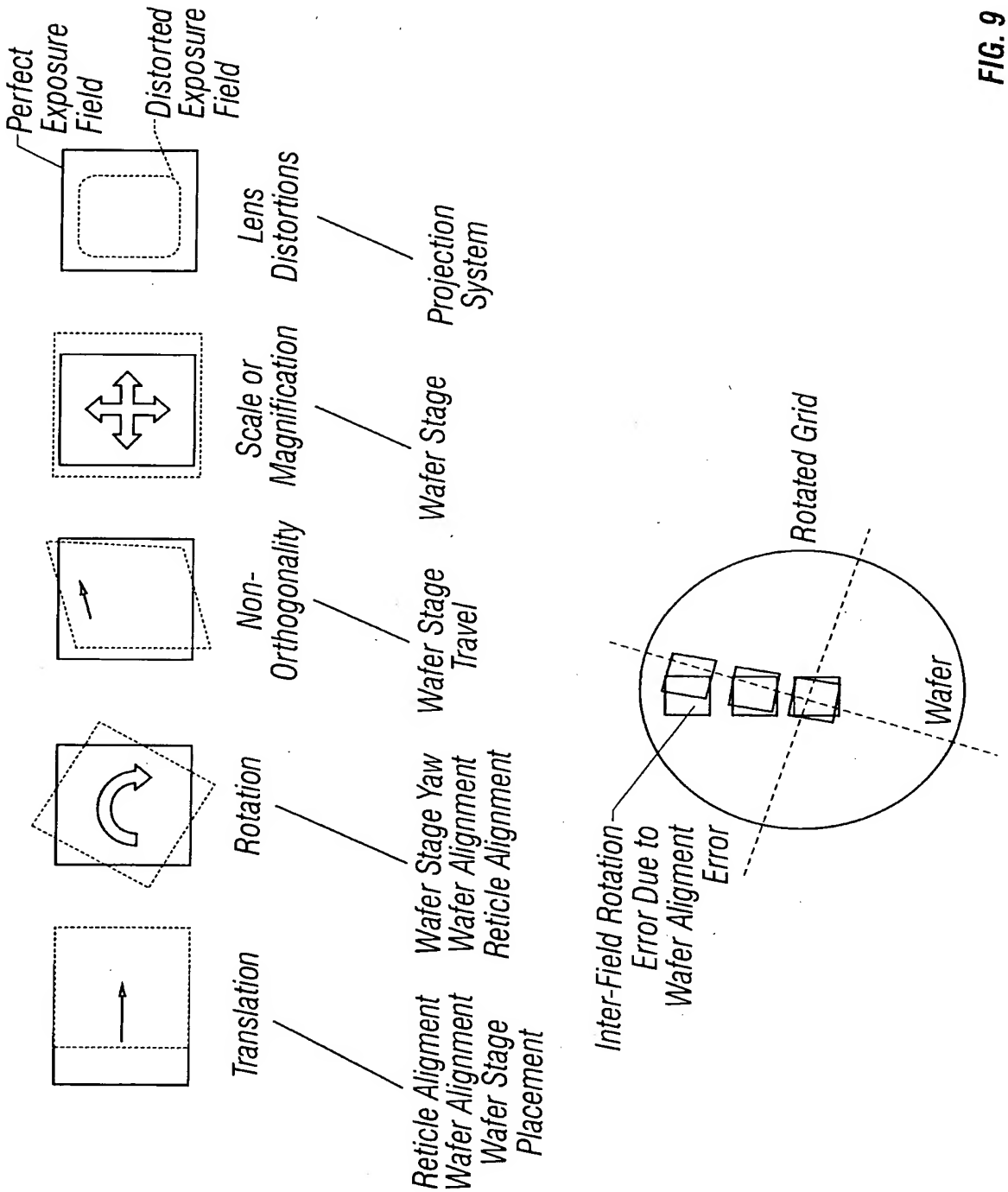

Perfect Exposure Field
Distorted Exposure Field
Lens Distortions
Projection System
Scale or Magnification
Wafer Stage
Non-Orthogonality
Wafer Stage Travel
Rotation
Wafer Stage Yaw
Wafer Alignment
Reticle Alignment
Translation
Reticle Alignment
Wafer Alignment
Wafer Stage Placement
Rotated Grid
Wafer
Inter-Field Rotation Error Due to Wafer Aligment Error

FIG. 9

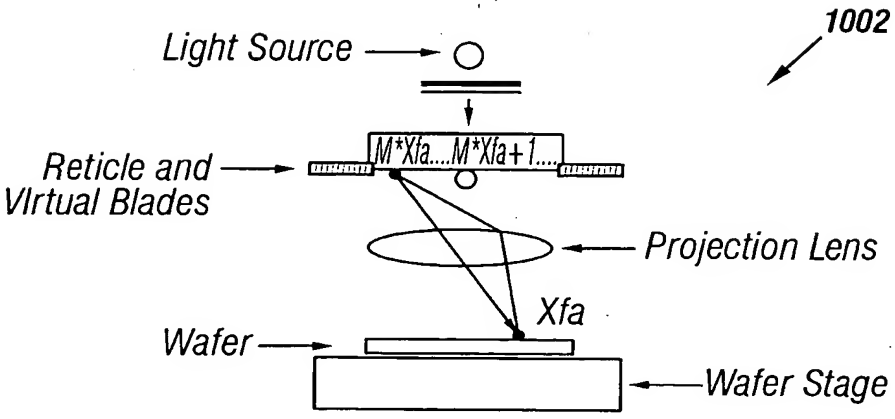


FIG. 10

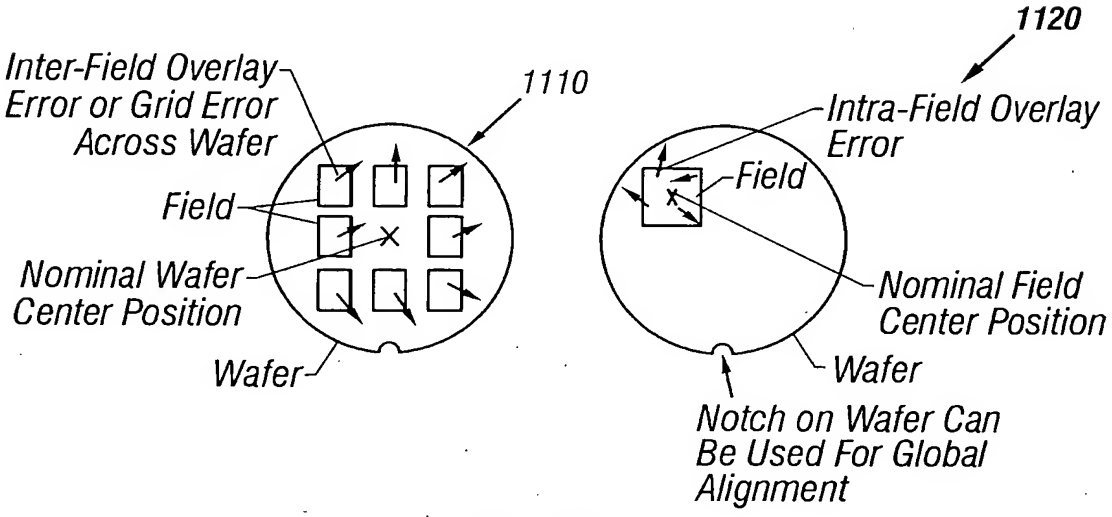


FIG. 11A

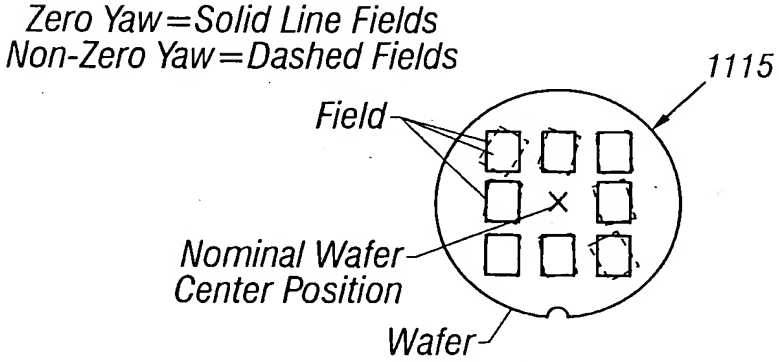


FIG. 11B

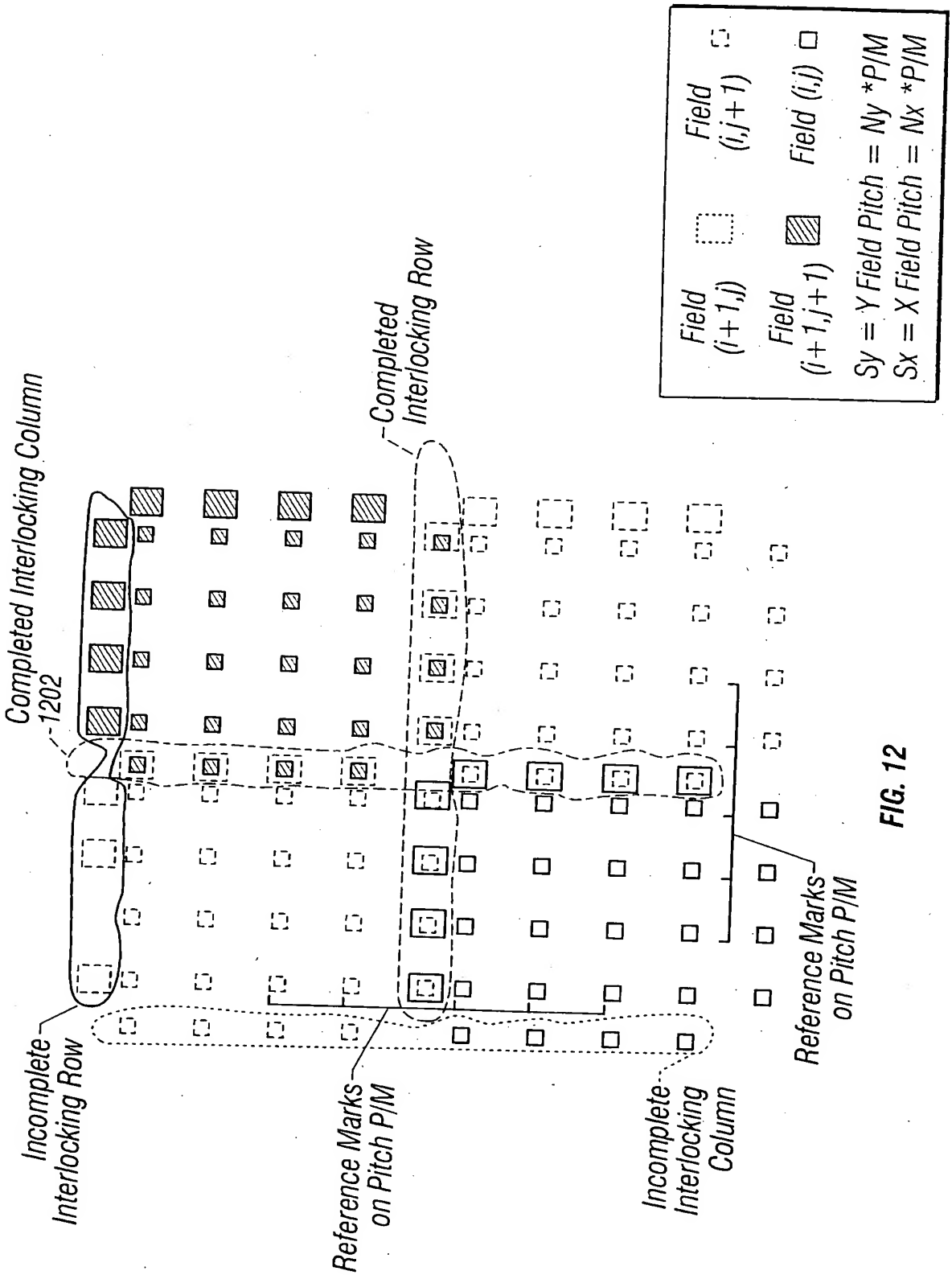

Field (i+1,j)
Field (i,j+1)
Field (i+1,j+1)
Field (i,j)
Sy = Y Field Pitch = Ny *P/M
Sx = X Field Pitch = Nx *P/M
Completed Interlocking Column
1202
Completed Interlocking Row
Incomplete Interlocking Row
Reference Marks on Pitch P/M
Incomplete Interlocking Column
Reference Marks on Pitch P/M

FIG. 12

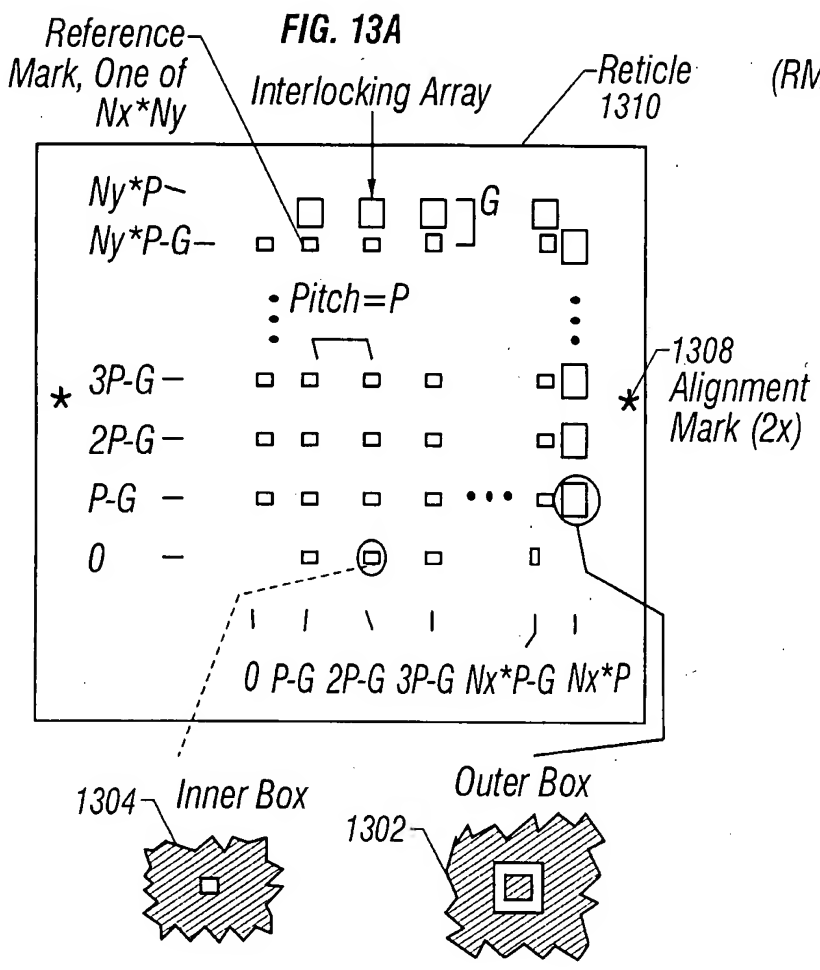


FIG. 13A

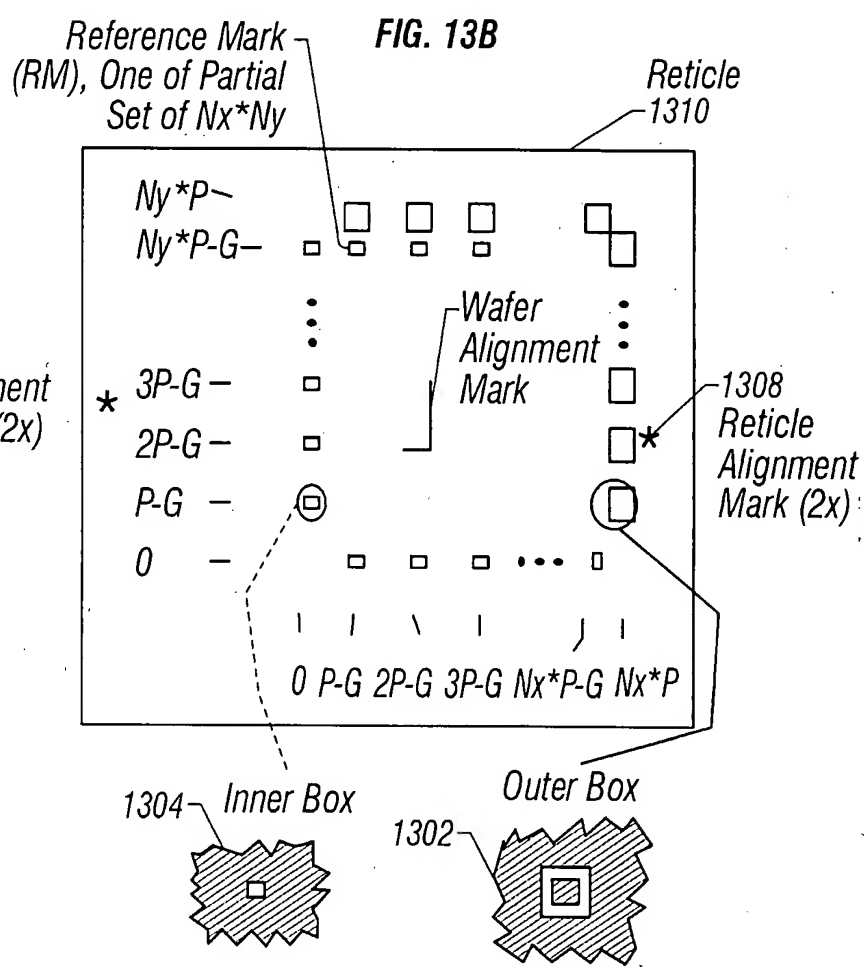


FIG. 13B

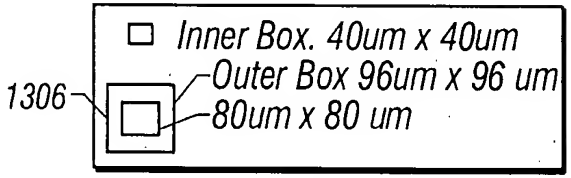


FIG. 13C

Heller Ehrman White & McAuliffe LLP
Title: "REFERENCE WAFER AND PROCESS FOR MANUFACTURING SAME"
Inventor(s): A. Smith et al.
Atty Docket No.: 38203-6081B
Application No.: 10/765,223 - Filed: 01/26/2004
8/19

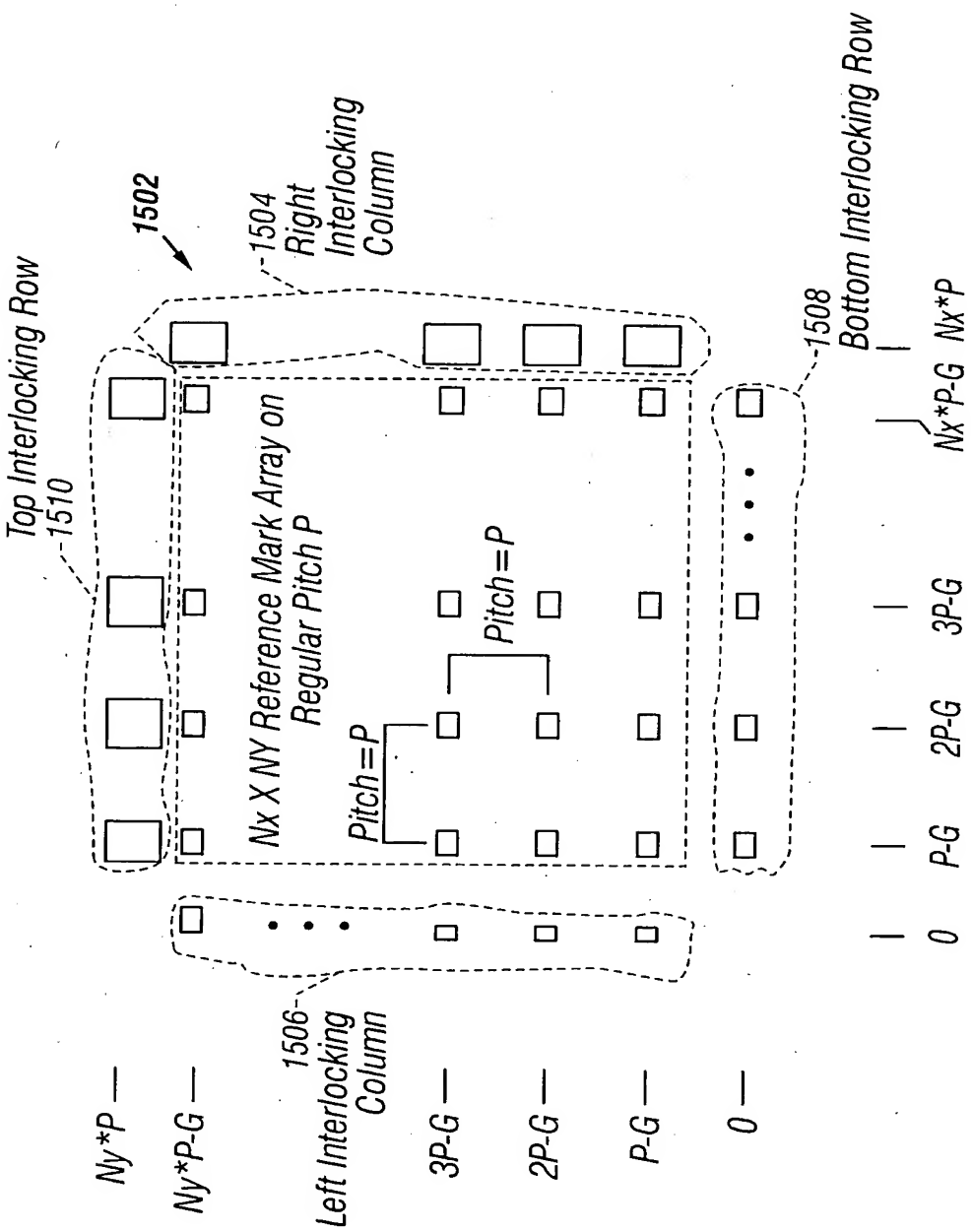

1502
1504 Right Interlocking Column
Top Interlocking Row
1510
Nx X NY Reference Mark Array on Regular Pitch P
Pitch=P
Pitch=P
1506 Left Interlocking Column
1508 Bottom Interlocking Row
Ny*P
Ny*P-G
3P-G
2P-G
P-G
0
Nx*P-G
Nx*P
3P-G
2P-G
P-G
0

FIG. 15

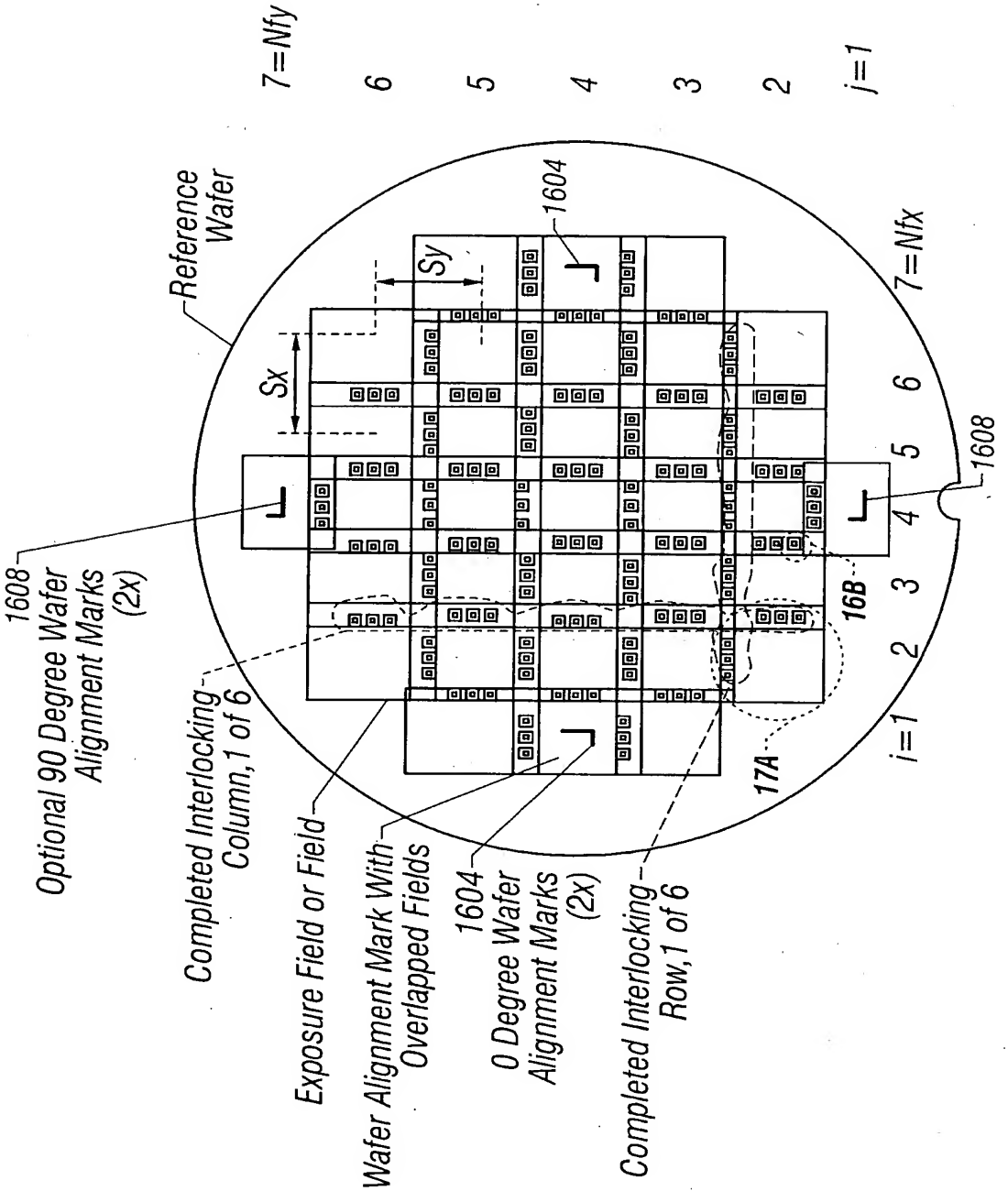

7=Nfy
6
5
4
3
2
j=1
Reference Wafer
1604
Sy
Sx
7=Nfx
6
5
4
3
2
1
i=1
1608
1608
16B
17A
Optional 90 Degree Wafer Alignment Marks (2x)
Completed Interlocking Column, 1 of 6
Exposure Field or Field
Wafer Alignment Mark With Overlapped Fields
1604
0 Degree Wafer Alignment Marks (2x)
Completed Interlocking Row, 1 of 6

FIG. 16A

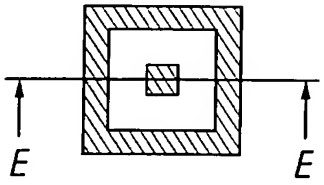


FIG. 16B

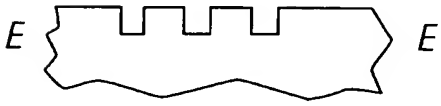


FIG. 16C

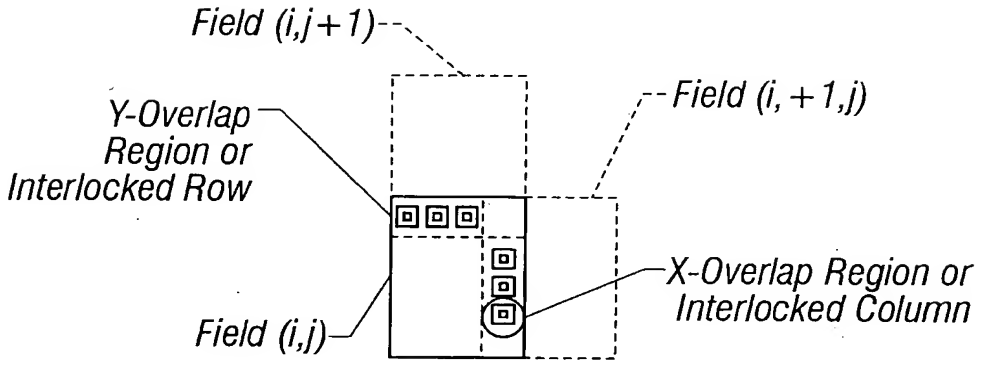


FIG. 17A

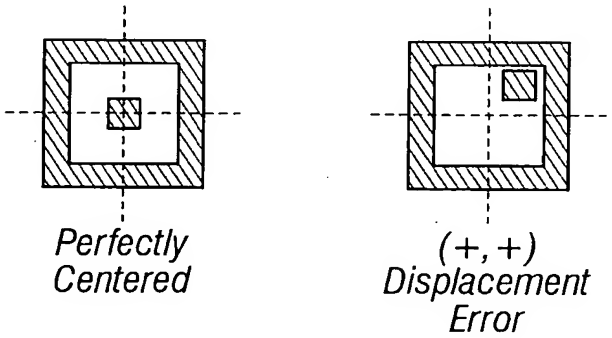


FIG. 17B

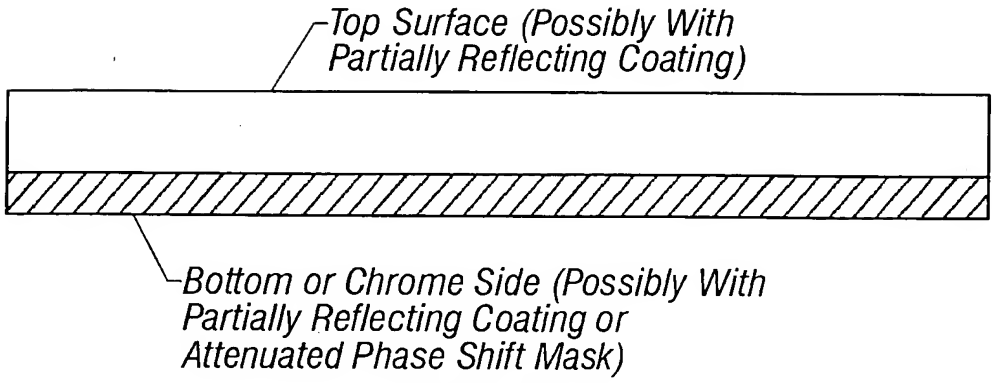


FIG. 14

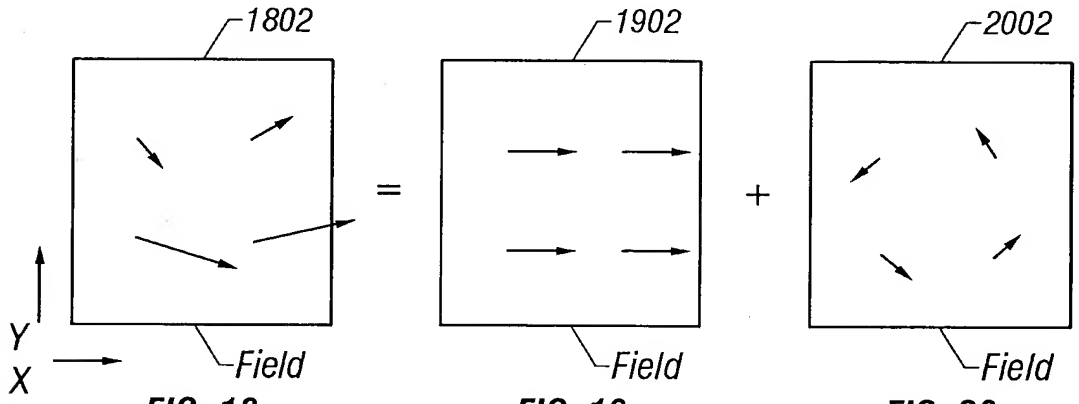


FIG. 18 FIG. 19 FIG. 20

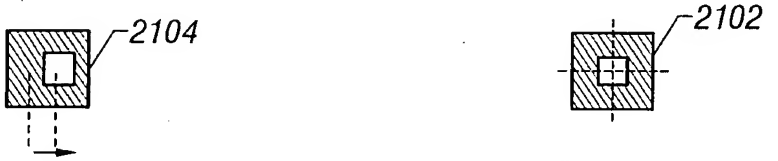


FIG. 21

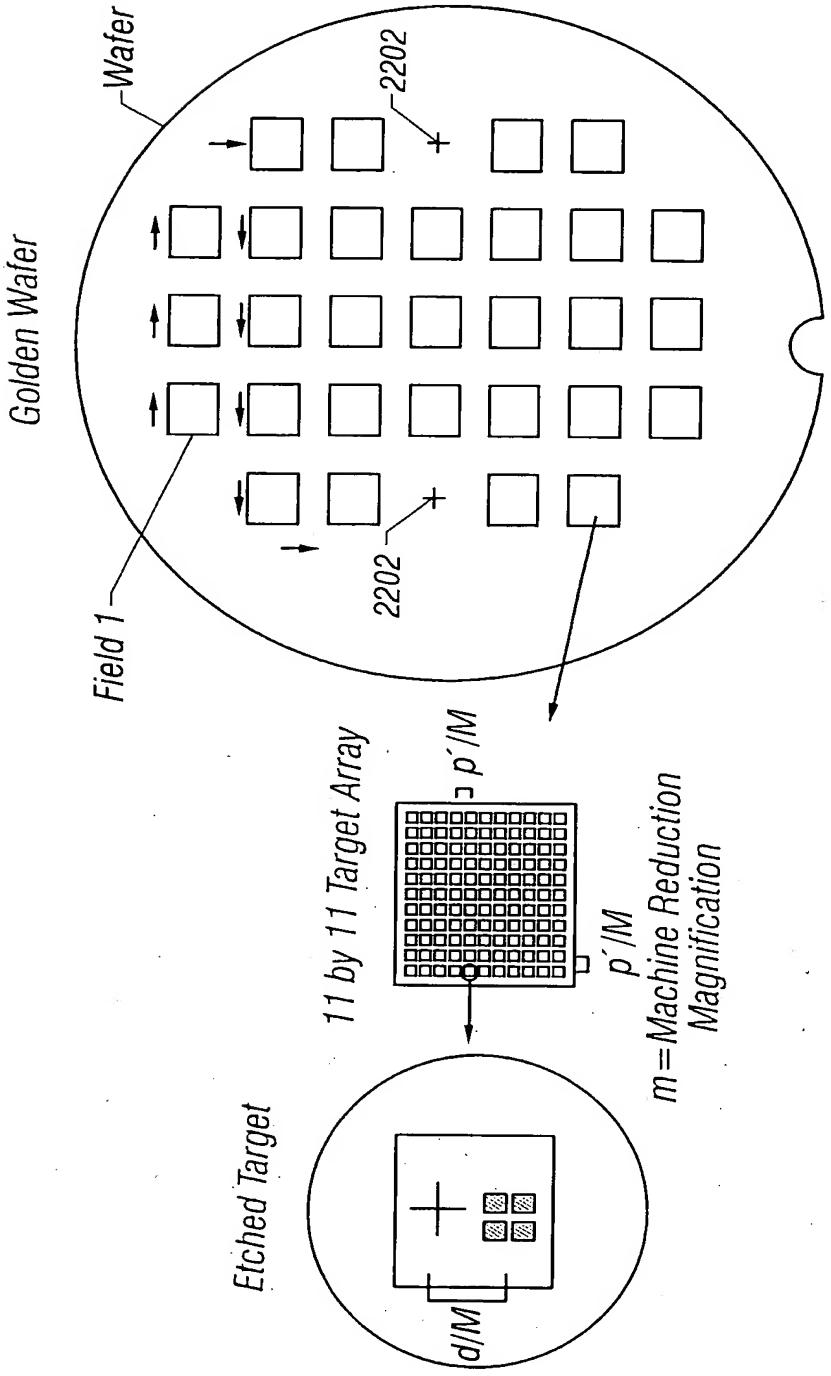

Wafer
2202
Golden Wafer
Field 1
2202
11 by 11 Target Array
p´/M
p´/M
m=Machine Reduction Magnification
Etched Target
d/M

FIG. 22

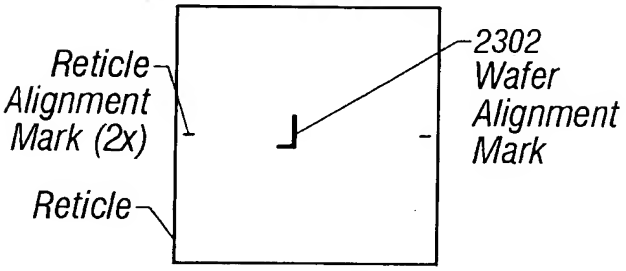


FIG. 23

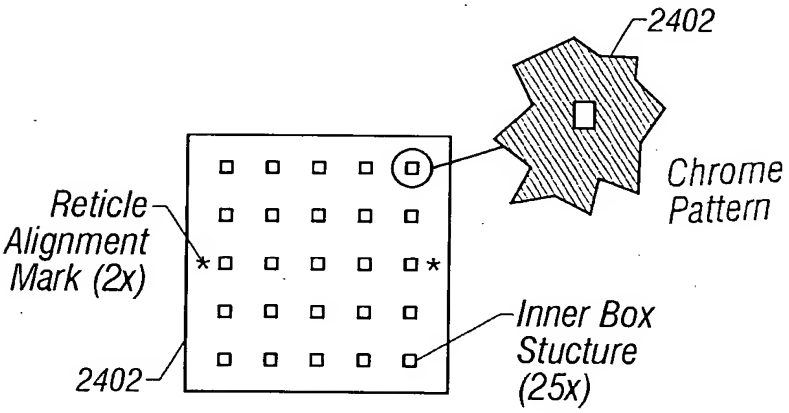


FIG. 24

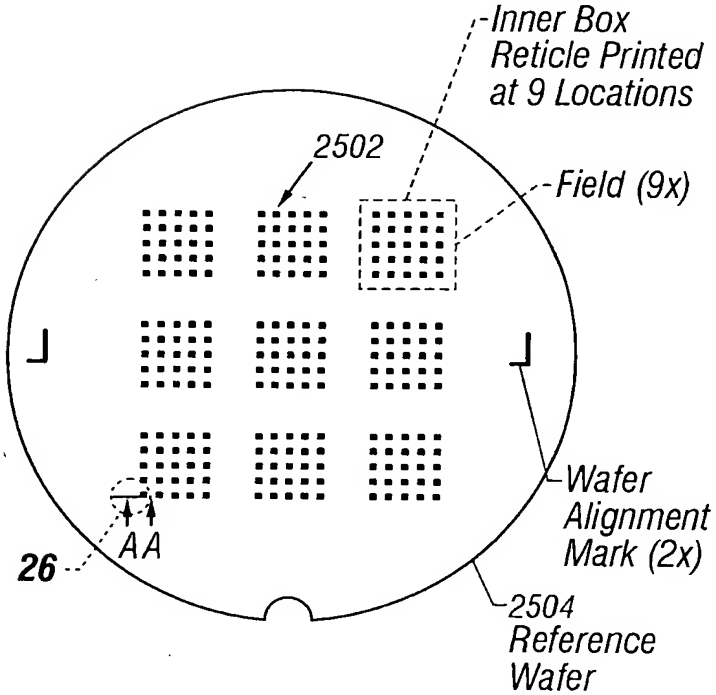


FIG. 25

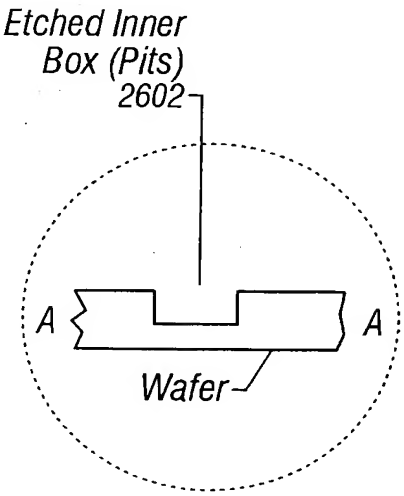


FIG. 26

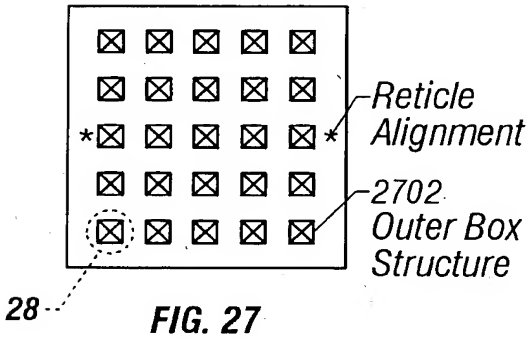


FIG. 27

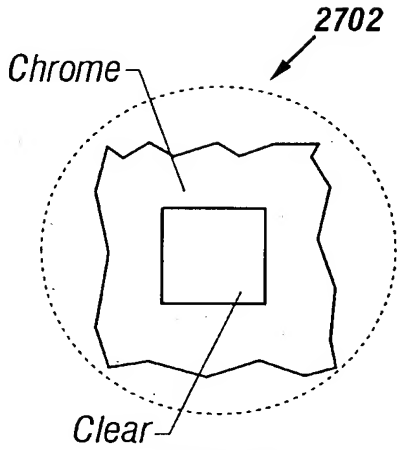


FIG. 28

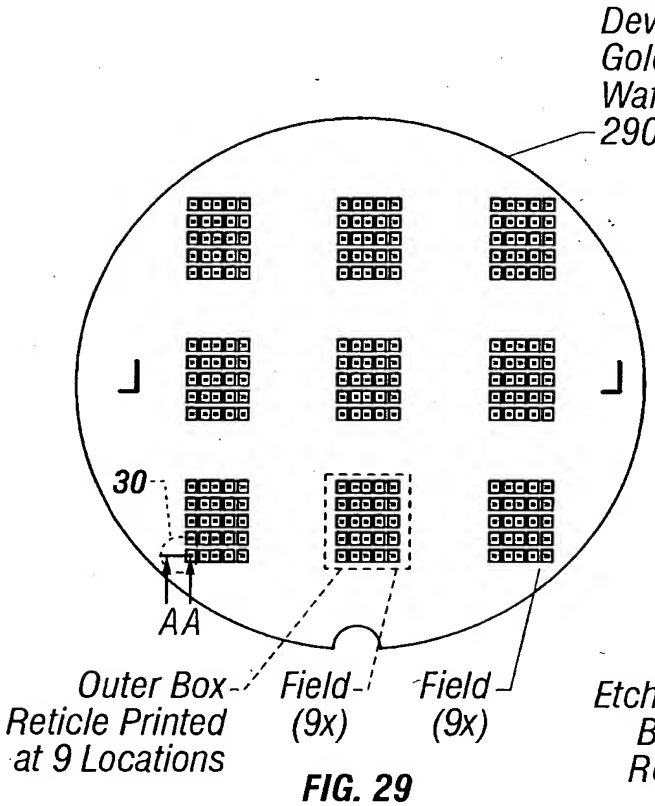


FIG. 29

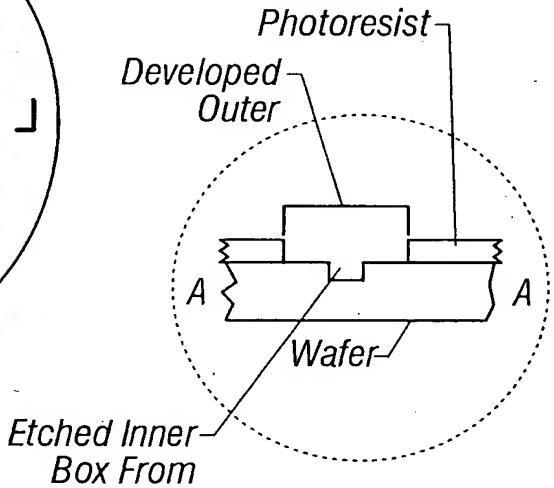


FIG. 30

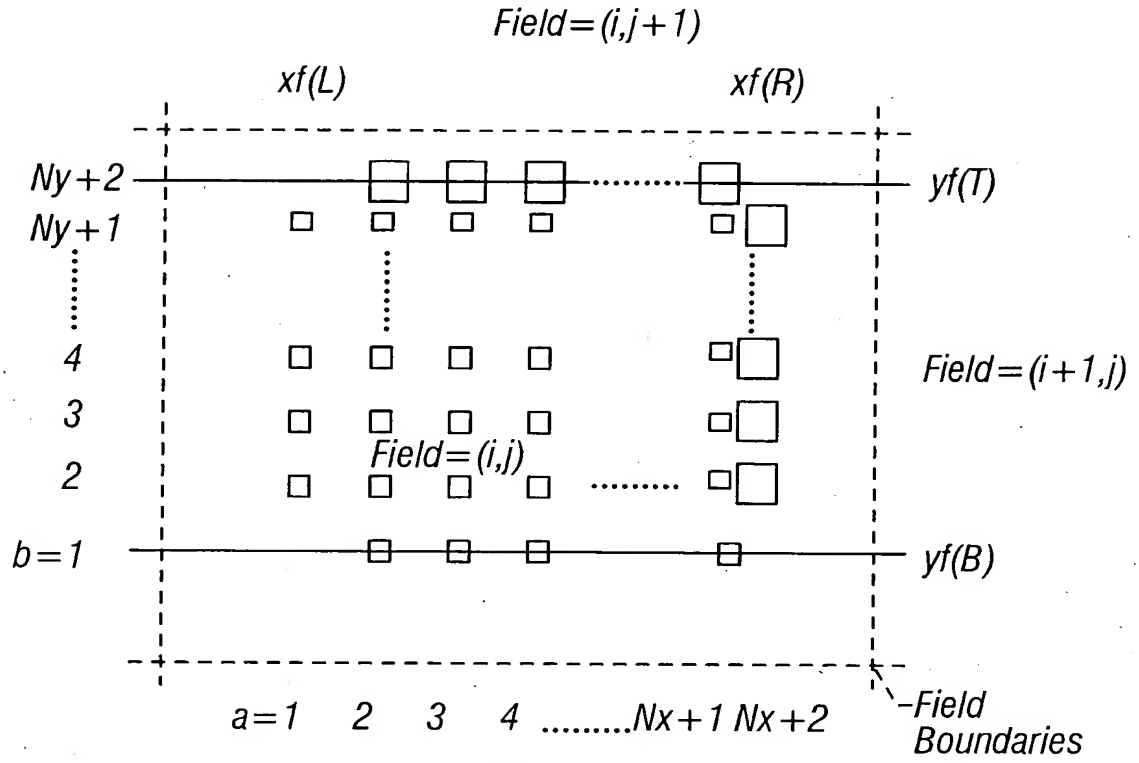

Field=(i,j+1)
xf(L)
xf(R)
Ny+2
Ny+1
4
3
2
b=1
yf(T)
Field=(i+1,j)
Field=(i,j)
yf(B)
a=1 2 3 4 .....Nx+1 Nx+2
Field Boundaries

FIG. 31

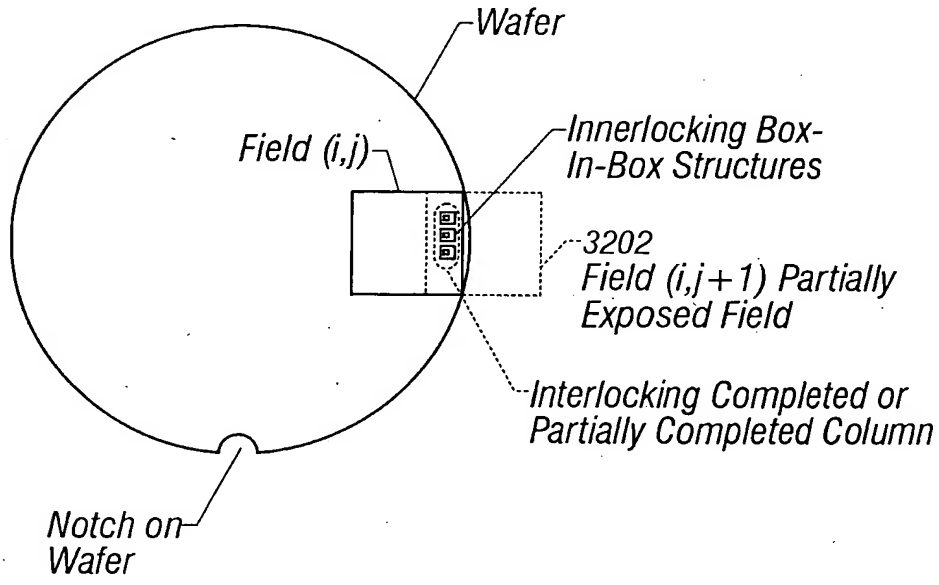

Wafer
Field (i,j)
Innerlocking Box-In-Box Structures
3202
Field (i,j+1) Partially Exposed Field
Interlocking Completed or Partially Completed Column
Notch on Wafer

FIG. 32

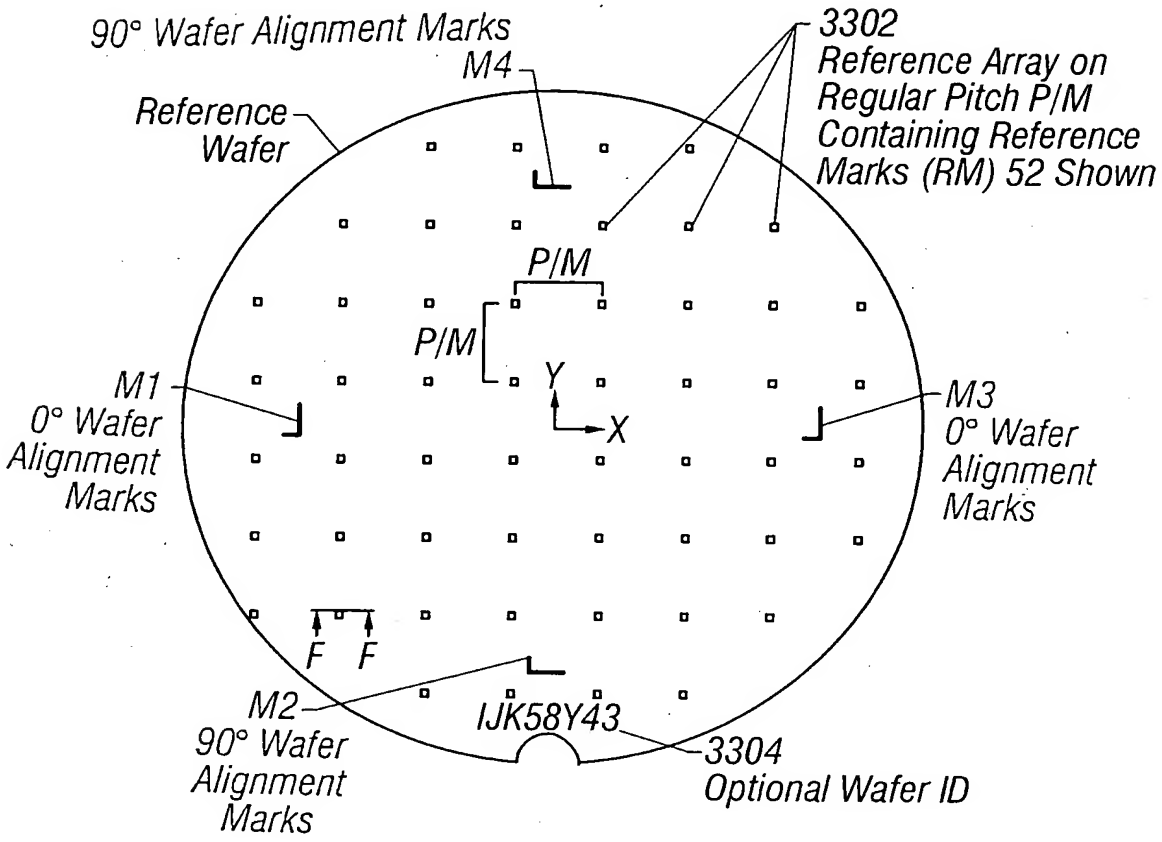
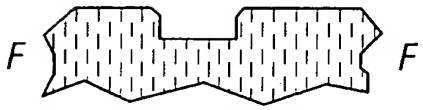


FIG. 33

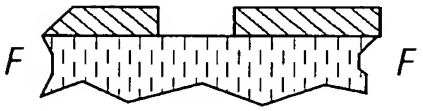
Feature	xG	yG	dx	dy
M1	-95.000000	0.000000	0.000050	-0.000037
M2	0.000000	-95.000000	-0.000387	0.000298
M3	95.000000	0.000000	0.000499	-0.000799
M4	0.000000	95.000000	0.000174	0.000274
RM	10.000000	10.000000	0.000598	0.000420
RM	10.000000	20.000000	0.000495	-0.000229
⋮	⋮	⋮	⋮	⋮
RM	-60.000000	-80.000000	0.000339	0.000449

52 Entries For Wafer of Figure 33

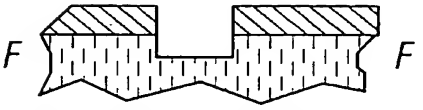
FIG. 34



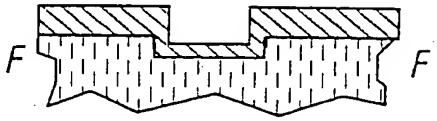
Pits in Wafer
FIG. 35A



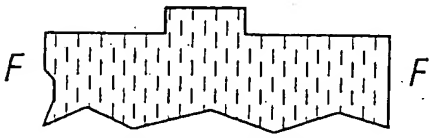
Pits in Overcoating
FIG. 35B



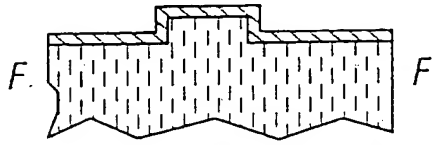
Pits in Overcoating & Wafer
FIG. 35C



Pits in Wafer Overcoated
FIG. 35D



Mound in Wafer
FIG. 35E



Overcoated Mound on Wafer
FIG. 35F

= Si or Substrate
= Deposited of Overcoat Layer

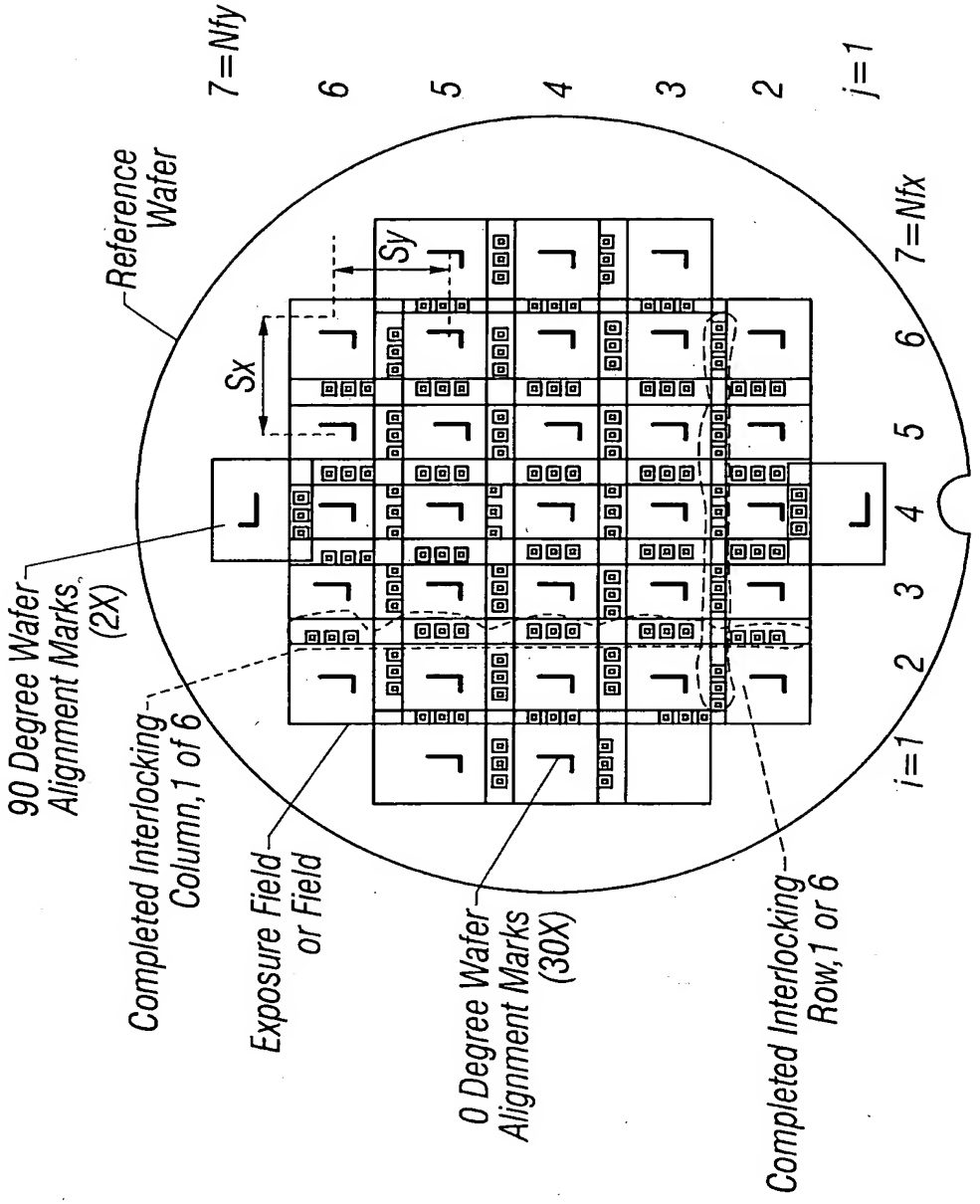

Reference Wafer
7=Nfy
6
5
4
3
2
j=1
7=Nfx
6
5
4
3
2
i=1
Sy
Sx
90 Degree Wafer Alignment Marks (2X)
Completed Interlocking Column, 1 of 6
Exposure Field or Field
0 Degree Wafer Alignment Marks (30X)
Completed Interlocking Row, 1 or 6

FIG. 36